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ABSTRACT

Sentence comprehension is more than a syntactically autonomous issue and relies on the clues that are not part of the grammar. This paper considers "world knowledge," in this case prior knowledge of the story being read, as one such clue. In section 1, "reversibility" of sentences is discussed. "Sentence ambiguity" is discussed in section 2. Section 3 is the experimental section that examines how world knowledge influences the interpretation of ambiguous sentences and affects linguistic development. The experiment was conducted to observe the fluctuation in subjects interpretation of ambiguous sentences and to analyze how knowledge of the story influences it. Sixty-five children in the Kyoto and Nara areas in Japan, aged 6-12, were given a strip of paper to read. After reading the strip of paper, the children were asked to act out what was written on the paper. The experiment showed that world knowledge plays an important role in sentence comprehension. It was concluded that world knowledge helps children in assigning an alternative structure they would not normally assign to the sentence. As a result of this, a child may become aware of the fact that a sentence can have more than one meaning. It is also concluded that the role of world knowledge seems to be related to maturation; younger children appear to be more influenced by world knowledge. (VWL)

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World Knowledge in Children's Sentence Comprehension

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0. Introduction

Sentence comprehension is more than a syntactically autonomous issue and relies on the clues that are not part of the grammar. In this paper, we will consider "world knowledge" as one such clue. In section 1, "reversibility" of sentences will be discussed. We will establish that the idea of world knowledge can create nonreversibility. "Sentence ambiguity" will be discussed in section 2. Section 3 is the experimental section which examines how world knowledge influences the interpretation of ambiguous sentences and affects linguistic development.

1 Semantic plausibility affecting sentence comprehension

1.1 Reversibility in sentence comprehension

Semantic plausibility and syntactic complexity affect sentence comprehension. Sometimes semantic factors seem even more crucial than syntactic complexity in accounting for children's sentence comprehension. Slobin (1966) studied the degrees of difficulty in sentence comprehension in terms of two aspects : (1) syntactic complexity between active (kernel) and passive structures with a grammatical transformation, and (2) reversibility and nonreversibility of the sentence. The following are the examples of sentences used in Slobin (1966):

1a. The dog is chasing the cat.
 b. The cat is being chased by the dog.

2a. The girl is watering the flowers.
 b. The flower is being watered by the girl.

Measuring the subject's response time (RT), he found that RTs for passive sentences (1b and 2b) were generally longer than RTs for active sentences (1a and 2a). This was taken to mean that the former underwent more grammatical transformation than the latter. This is what derivational theory of complexity (DTC) predicts. On the other hand, if the sentences were nonreversible, the difficulty of passivity was eliminated. Nonreversible sentences (2) generally took less RT than alternative reversible sentences (1). Interestingly enough, RT for (2b) was roughly equal to that of (1a), or even a little shorter. This is due to the relative ease of decoding meaning; whereas in (1a) and (1b) either NP, "the cat" and "the dog" could possibly be the subject NP, (2b) and (2a) allow only one of the two, -"the girl"- to be the probable subject of the action, thus reducing the probability of confusion.

In the following section, sentence reversibility will be discussed in more detail.

1.2 Knowledge of the world as non-linguistic factors

In the previous section, semantic plausibility, which influences reversibility of a sentence, was discussed in terms of the lexicon. In this section, we will discuss how "world knowledge" can also influence reversibility of a sentence. Let us continue to discuss the reversibility of the following sentences in which characters of the classic stories Don Quixote and Snow White appear.

3a. Don Quixote spared the windmills.
 b.*The windmills spared Don Quixote.

4a. The witch gave Snow White an apple.
 b.?Snow White gave the witch an apple.

Sentence (3a) could easily be considered a nonreversible sentence because the reversed version (3b) is judged implausible. An inanimate NP "the

windmill" cannot serve as the AGENT in the subject position of the action "spare." Such lexical information may alone be enough to account for the implausibility and the nonreversibility of (3b), irrespective of the plot of Don Quixote.

On the other hand, the plausibility of (4b) is in question for a different reason. From the perspective of the lexical information, (4a) should be considered a reversible sentence because either of the NP's "Snow White" or "the witch" can logically serve as the AGENT in the subject position of the VP "give x an apple." However, (4b) may frequently be rejected or at least cause hesitation in accepting it as plausible, if we assume the knowledge of the plot of the story makes sentence (4b) sound implausible. Assuming that such a special character like "Snow White" as an argument of a sentence requires a special situation to be represented to be in accordance with the story, we could explain why (4b) is implausible and (4a) is nonreversible.

An experiment performed to test this assumption used the following sentences:

5a. ouji-sama-wa nige-ta sinderera-o oikake-ta
the prince NOM escape PAS Cinderella ACC chase PAS
"The prince chased Cinderella who had escaped."

b. sinderera-wa nige-ta ouji-sama-o oikake-ta
Cinderella NOM escape PAS the prince ACC chase PAS
"Cinderella chased the prince who had escaped."

(5a) is plausible while (5b) is not in a sense even though they are identical in terms of syntactic structure, if we assume that the special character "Cinderella" accompanied by "the prince" requires a certain situation in which "she runs away from the prince." While most children could correctly reconstruct what (5a) says by acting it out with cutouts many of them failed to do so for (5b). We may say that it is the implausibility due to knowledge of the story of Cinderella that hindered the children in sentence interpretation.

Section 3 presents an experiment to study the

effect of knowledge of the story on comprehension of more complex sentence structure, namely, structurally ambiguous sentences. Before turning to this point, section 2 will discuss another way of looking at sentence comprehension which will be seen to play an important role in the experiment outlined in section 3.

2. Sentence ambiguity

Ambiguous sentences are often useful in examining children's linguistic ability. Given a sentence which has two meanings, it is predicted that some would interpret it only one way, and others both ways. Among those who would realize both meanings of the sentence, some would realize only one meaning at a time and stumble across the alternative interpretation by chance, whereas others would be fully aware from the beginning that the sentence can have two meanings. Linguistic maturity of children is reflected in their response to sentence ambiguity. Otsu (1987) proposes an analysis of the relationship between children's ability to detect sentence ambiguity and the development of grammatical competence. The sentence used to illustrate this point is as follows.

(1). Taro-kun-wa jitensha-de nige-ta Hanako-san-o
TOP bicycle INST escape PAS ACC

oikake-mashi-ta.
chase POLITE PAS

TOP:Topic, INST:Instrumental, PAS:Past, ACC:Accusative

Its ambiguity can be captured by assigning the following two structures involving relative clauses, which are indicated by brackets.

(2). Taro-kun-wa [jitensha-de nige-ta Hanako-san]-o oikake-mashi-ta.
"Taro chased Hanako, who had escaped by bicycle."

(3). Taro-kun-wa jitensha-de [nige-ta Hanako-san]-o oikake-mashi-ta.
"Taro chased hanako, who had escaped, by bicycle."

Thus, the two readings are made available by the fact the instrumental phrase jitensha-de "by bicycle" can be either inside or outside the relative clause.

It is discussed in Otsu that there were a considerable number of subjects who correctly understood both (2) and (3) but failed to detect ambiguity of (1). We can recognize from this that the ability to detect the sentence ambiguity belongs to a higher level of cognitive skill, called metalinguistic awareness, which is not a part of one's grammar. In the following experiment, I will mainly discuss the influence of world knowledge on children's assignment of structures to ambiguous sentences. Metalinguistic awareness will be another concern in this experiment because analyzing ambiguous sentences involves the ability to detect the ambiguity of a sentence apart from structure assignment to it.

3 Experiment

The purpose of the experiment in this chapter is to observe the fluctuation of the subjects' interpretation of ambiguous sentences (discussed in section 2) and analyze how knowledge of the story (discussed in section 3) influences it.

3.1 Material

The following three sentences, (6), (7), and (8) are modeled after Otsu (1987). Each of the sentences involves sentence ambiguity of the type discussed in section 2. (7) and (8) also involve the characters of the popular fairy tales: "Cinderella" and "the prince" in Cinderella, and "Songoku" and "the monster" in a Chinese story Saiyuki, or "Journey to the West." The instruments "glass slippers" and "Kintoun" belong to

"Cinderella" and "Songoku" respectively. "Hanawa-kun" and "Maruo-kun" in (6) are also involved in a popular Japanese comic strip series Chibimaruko-chan but no semantic constraint referred to in (7) or (8) is expected.

6. Hanawa-kun-wa rorasuketo-de nige-ta
TOP rollerskate on escape PAS

Maruo-kun-o oikake-ta
ACC chase PAS

6a. Hanawa-kun-wa [rorasuketo-de nige-ta
TOP rollerskate on escape PAS

Maruo-kun]-o oikake-ta
ACC chase PAS
"Hanawa chased Maruo, who had escaped on rollerskates"

6b. Hanawa-kun-wa rorasuketo-de [nige-ta
TOP rollerskate on escape PAS

Maruo-kun]-o oikake-ta
ACC chase PAS

"Hanawa chased Maruo, who had escaped, on rollerskates"

7. ouji-sama-wa garasu-no-kutsu-de nige-ta
the prince TOP glass slippers on escape PAS

sinderera-o oikake-ta
Cinderella ACC chase PAS

7a. ouji-sama-wa [garasu-no-kutsu-de nige-ta
the prince TOP glass slippers on escape PAS

sinderera] -o oikake-ta
Cinderella ACC chase PAS

"The Prince chased Cinderella, who had escaped on glass slippers."

7b. ouji-sama-wa garasu-no-kutsu-de [nige-ta
the prince TOP glass slippers on escape PAS

sinderera] -o oikake-ta
Cinderella ACC chase PAS

"The prince chased Cinderella, who had escaped, on glass slippers."

8. Songoku-wa kintoun-de nige-ta
TOP on escape PAS

yokai-o oikake-ta
the monster ACC chase PAS

8a. Songoku-wa [kintoun-de nige-ta
TOP on escape PAS

yokai]-o oikake-ta
the monster ACC chase PAS

"Songoku chased the monster, who had escaped on Kintoun."

8b. Songoku-wa [kintoun-de nige-ta
TOP on escape PAS

yokai]-o oikake-ta
the monster ACC chase PAS

"Songoku chased the monster, who had escaped, on Kintoun."

TOP: Topic, PAS: Past, ACC: Accusative

The ambiguity of (6), for example, is due to the position of the PP <u>rorasuketo-de</u> "on rollerskates" which can be either inside or outside of the relative clause and thus allows the interpretations (6a) and (6b) in which the relative clauses are indicated by brackets. The other two sentences, (7) and (8) are identical to (6) in terms of syntactic structure where the PP may be interpreted as either part of the relative clause (interpreted as "a") or the main clause (interpreted as "b"). However, if the plot of the

stories are fully regarded, the interpretation of (7a) and (8b) would sound more natural because the situation represented by those sentences are just what the stories predict, and (7b) and (8a), the alternatives, would sound odd because they represent situations that could hardly be realized if the readers restrict the sentences to expectations based on their knowledge of the characters of the stories.

3.2 Procedures

The experiment was carried out in two stages. First, a strip of paper on which a sentence was written was presented to the subjects individually. Each word in the sentence was shown at the equal intervals and no punctuation was given so that no extra information about juncture would be provided. Then, the subjects were told to act out the situation represented in the sentence with paper cutouts. When the subjects finished acting, the researcher asked them "That's it?" and "Can you think of anything else?" in order to give them the chance to make their own comments about the sentence and refer to the ambiguity if they noticed it.

At each performance, the subjects were categorized into three groups according to their interpretations. Those who parsed the instrumental phrase "rorasuketo-de", "garasu-no-kutsu-de", or "kintoun-de" as part of the main clause were marked "MC", as part of the relative clause were marked "RC", and those who pointed out both possibilities were marked "Both."

3.3 Subjects

The subjects for this experiment were 65 children selected from 90 monolingual elementary school students in the Kyoto and Nara area in Japan: 30 lower graders (the 1st and 2nd grades), 30 middle graders (the 3rd and 4th grades), and 30 higher graders (the 5th and 6th grades). Ages varied from 6 to 12 years old. The 65 children for the subjects were chosen through a preliminary experiment. The purpose of the preliminary

experiment was to exclude the children who did not correctly understand the very essential part of the relative clause structure. The sentence used is below:

9. Hanawa-kun-wa nige-ta Maruo-kun-o oikake-ta
TOP escape PAS ACC chase PAS

"Hanawa chased Maruo, who had escaped."

After telling them to act out the situation with the cutouts, only those who took "Hanawa-kun" as the chaser and "Maruo-kun" as the one being chased were chosen as the subjects of the experiment.

Among the 65 chosen subjects, 17 were from the lower grades (L), 22 were from the middle grades (M), and 26 were from the higher grades (H). It was determined before the experiment that they all knew the stories of Cinderella and Saiyuki.

3.4 Predictions

Two predictions can be made about how the knowledge of a story affects the interpretation of a sentence. Many seem to have their own idiosyncratic preference as to whether the PP is in the relative clause or the main clause. The experiment was designed to see what happens when their preference is inconsistent with their knowledge of the story, and whether the conflict will prevent them from realizing the possibility of alternate interpretations. If one understands the instrumental PP to be in the main clause in (6) and chooses the interpretation of (6a), he/she is also likely to decide on the interpretation (7a), which would cause inconsistency with the story Cinderella. On the other hand, if one understands the PP to be inside the relative clause in (6) and chooses the interpretation of (6b), one would expect him/her to have the interpretation (7b) then (8b), which would cause inconsistency with the story Saiyuki. Now one would predict that the subject would either: (1) retain his preferred interpretation in spite of the inconsistency, or (2) discover alternate

interpretations of the sentence. Table 1 below shows the expected distribution of judgments of sentences (6), (7), and (8) where the letters A through I stand for the expected percentage of population which belongs to each category. Figure 1 presents the two predictions of the population discussed above corresponding to each category shown in Table 1 .

Table 1.

	RC	MC	Both
6	A	D	G
7	B	E	H
8	C	F	I

RC: (in the) relative clause
MC: (in the) main clause

Figure 1

prediction (1)
A=B=C D=E=F
prediction (2)
C<A<B E<D<F

Careful attention should also be paid to the changes in G, H, and I in Table 1, the population of which could detect the ambiguity.

3.6 Results and Discussion

The detailed figure indicating the number of the subjects falling into each category is shown in Table 2 below.

Table 2

	RC	MC	Both
6	35.4	46.1	18.5
7	56.9	15.4	27.7
8	9.2	55.4	35.4

The figure is in accordance with my prediction (2). While 35.4% of the subjects interpreted the instrumental PP to be inside the relative clause in (6), the "neutral" sentence in terms of the relationship with the story, as many as 56.9% of the subjects did so in (7) but only 9.2% did so in (8). On the other hand, 46.1% interpreted the instrumental PP in the main clause in (6), and 55.4% did so in (a) while as little as 15.4% did so in (7). This means a good number of the subjects changed their way of processing sentences so that the representation of the sentence would agree with their expectations and rejected the situation which was inconsistent with it.

Now let us look at the percent responses of each age group, L, M, and H. Table 3, 4,and 5 show the percent response of each age group for sentence (6), (7), and (8), respectively.

Table 3. Percent responses for (6)

	L	M	H	Total
RC	47.1	31.8	30.8	35.4
MC	47.1	54.5	38.4	46.1
Both	5.8	13.7	30.8	18.5

Table 4. Percent responses for (7)

	L	M	H	Total
RC	88.2	45.4	46.2	56.9
MC	11.8	27.3	7.6	15.4
Both	0.0	27.3	46.2	27.7

Table 5. Percent Responses for (8)

	L	M	H	Total
RC	11.8	13.4	3.8	9.2
MC	82.4	54.5	38.5	55.4
Both	5.8	31.8	57.7	35.4

The influence of world knowledge was especially prominent in lower graders (L) as great increases in the percentage of subjects in RC in sentence (7) and MC in sentence (8) show, while increases are not remarkable if we look at only middle and higher graders (M and H.) To borrow the Gleitmans' phrase, "the tendency to reject implausible but 'correct' sentences diminishes with the older subjects."

The 15.4% of the population who parsed the PP as part of the main clause in (7) and the 9.2% who parsed the PP as part of the relative clause are the people who were not influenced by the knowledge of the story and rather stuck to their idiosyncratic preference as to whether to parse the PP as part of the relative clause or the main clause.

As the population of each category indicating those who interpreted the PP as being RC or MC fluctuates with the influence of the stories, we should notice that the category for the people who got both interpretations kept increasing. The percentage of the whole population categorized into "both" was 18.5% in (6), 27.7% in (7), and 35.4% in (8). As I have

mentioned in the last section, children who succeed in detecting sentence ambiguity are considered to be at a more sophisticated level of linguistic awareness that those who do not. After having seen sentences in which PP-location does not affect the sentence's meaning and sentences in which it does, some of the subjects appeared to realize that a certain structure of a sentence allows more than one interpretation.

We shall now look more carefully into the subjects of the category "Both" of each L, M, and H graders. It should be noted here that no increase in number of lower graders was seen -- 5.8% in (6), 0.0% in (7), and 5.8% in (8)--, while a considerable increase was seen in middle and higher graders. Only lower graders failed to detect the sentence ambiguity although many of them were exposed to sentences in which alternative interpretations were possible.

From what has been shown above, we can roughly conclude that world knowledge (here, knowledge of the stories) plays an important role in sentence comprehension: (1) World knowledge helps children in assigning an alternative structure they would not normally assign to the sentence. As a result of this, a child may become aware of the fact that a sentence can have more than one meaning. If the child becomes fully conscious of it, this increases his/her metalinguistic awareness. (2) The role of world knowledge seems to be related to maturation. Younger children (mostly lower graders, under 8 years old) are more readily influenced by world knowledge. As can be seen from the results, the interpretation as to whether the PP is in the main or the relative clause fluctuated strongly because of the bias provided by the knowledge of the stories. However, even though some children assigned two different structures to (7) and (8), they were not aware of the fact that they did so. Children over a certain age (mostly children in higher grades, i.e., over 10 years old) were less accepting of world knowledge. They were found to be better at detecting sentence ambiguity. This is presumably because when children are young, they have very little information

coming from their own grammar. Once they get older, children have enough information from their grammar so that they do not require much non-linguistic information.

In a normal situation, syntax, to a great extent, offers clues into the semantic representation of a sentence. If such syntactic guidance is not available, one can guess the meaning of the sentence by making use of world knowledge. This first attempt at decoding the meaning, i.e., the semantic interpretation arrived at by the child through his/her world knowledge, may be sensed as some sort of a temporary bridge between the real semantic representation of a given sentence and its syntactic structure. This temporary bridge is often discarded and the real semantic representation is arrived at; though, sometimes, it may become a part of the child's emerging grammar.

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*This paper is based in part on my BA thesis, An Experimental Analysis of Perceptual Strategies in Children: Cues for Sentence Comprehension, submitted to Doshisha University in 1991. One of the experiments which I conducted for my thesis research is referred to here as the preliminary experiment.

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